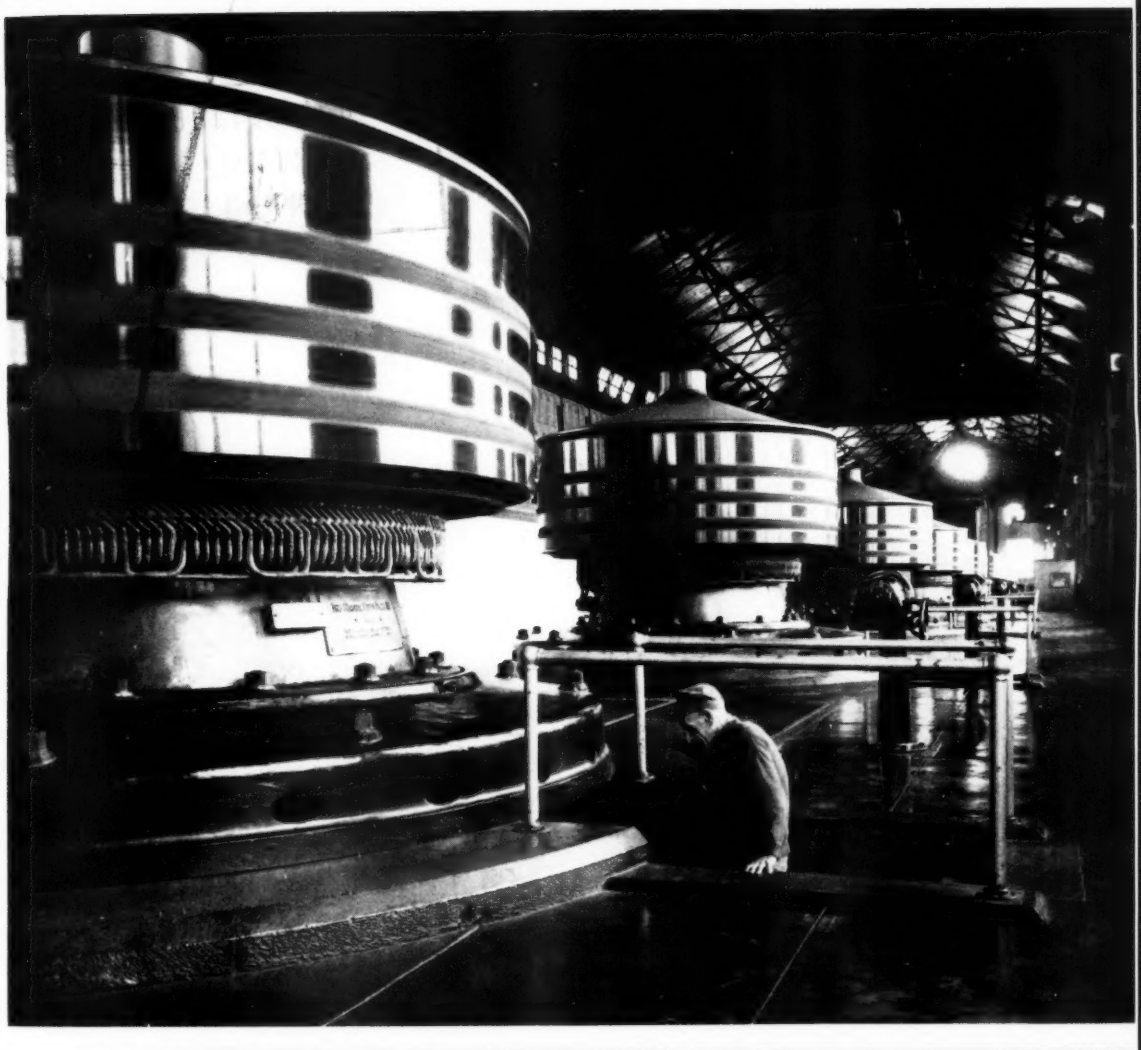
CHNOLOGY DEPT

# Midwest Engineer

SERVING THE ENGINEERING PROFESSION



WESTERN SOCIETY OF ENGINEERS FOUNDED 1869

ORE HANDLING AND CRUSHING SYSTEM—PAGE THREE

WSE MEETINGS—PAGE TWO

Vol. 6 JANUARY, 1954 No. 8

# *Your Pet Project* MAY BECOME A PRIZE PAPER

**Jot down the ideas you've had for a long time . . .**

**Maybe they'll help you think of others . . . Maybe they'll win you one of the five, $100 prizes**

**Here are the rules:**

Any member of the Society may compete regardless of grade of membership.

Papers shall not be highly technical in nature. A clear, concise and interesting coverage is desired rather than complex formulae or derivations. The subject discussed should be of general interest to engineers but should not be of a political or highly controversial nature.

All members of the Society who wish to submit papers in this contest should contact the Secretary as early as possible and not later than February 1, 1954, and request a copy of the rules governing the competition and an outline of the minimum requirements for acceptance of papers. These cover in detail the mechanical make-up which should be followed in preparing and submitting papers for the contest.

Papers must be submitted to the Secretary for acceptance by April 1, 1954. If the Secretary finds that they meet the minimum requirements of the contest, he will forward them to the Awards Committee for review. The papers will be identified by number only. The Secretary of the Society is the only person who will maintain the key to the authors.

If any paper does not comply with such minimum requirements, the Secretary will so advise the author and discuss with him the points which are below the minimum requirements. The papers which are accepted will be forwarded to the Awards Committee for judging not later than May 1, 1954. Papers which have not met the minimum requirements by that time cannot be considered for prizes.

Papers which are accepted will be judged on originality of presentation, editorial merit and value to the engineering profession.

The papers submitted must not have been previously published in substantially the same form. No copyrighted materials shall be used unless permission has been obtained and so indicated. All manuscripts, drawings, etc., are to become the property of the Society and cannot be published without the consent of the Society.

If the papers submitted are NOT of sufficient merit to warrant the award of any or all of the prizes, the Awards Committee reserves the right to award less than the five established prizes or to postpone the competition.

The winners will be announced and the prizes presented at the annual meeting of the Society in June, 1954.

**WSE Executive Secretary will furnish you with a complete set of rules and minimum requirements on request.**

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*Serving the Engineering Profession*

JANUARY, 1954 Vol. 6, No. 8

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### COVER STORY

The three generators in the foreground of the picture began operating 58 years ago on Oct. 27, in the world's first large power installation—the Edward Dean Adams power station of Niagara Mohawk Power Corporation. Rated at 5,000 electrical horsepower, the generators are still in service today. Since these machines were installed, the nation's electric power industry has grown at a phenomenal rate until today the installed generating capacity for the United States alone is about 85,000,000 kilowatts.

—Westinghouse Photo

## January 5, Fire Protection and Safety Section

Speaker: G. W. Daubenspeck, senior industrial hygiene engineer, Illinois Department of Labor.

Subject: "New Developments in the Control of Industrial Health and Fire Hazards."

## January 6, Noon Luncheon Meeting

Speaker: F. W. Schlesinger, director, Adler Planetarium.

Subject: "Activity on the Sun."

## January 11, WSE General Program

Speaker: Dr. Charles F. Wagner, consulting engineer, Westinghouse Electric Corp.

Subject: "Ramblings of an Engineer in Europe."

## January 12, Junior Meeting

Speaker: John L. Carr, supervisor, Meigs Field, Chicago.

Subject: "Meigs Field—Past, Present, and Future."

## January 13, Noon Luncheon Meeting

Speaker: James LaBelle, civil engineer, Chicago Water Distribution Division.

Subject: "Public Water Supply for Fire Protection at the Prudential Building."

## January 20, Noon Luncheon Meeting

Speaker: A. C. Kalmbach, president, Kalmbach Publishing Company.

Subject: "Engineering in 100:1 scale, or Model Railroading Is Fun."

## January 20, Consulting Engineers' Division

See notice in box on this page.

## January 21, Chemical and Metallurgical Section

Speaker: F. K. Lindsay, assistant manager, Zeolite Department, National Aluminate Corp.

Subject: "Ion Exchange Resins."

## January 25, WSE General Program

Speaker: Dr. J. T. Rettaliata, president, Illinois Institute of Technology.

Subject: "Living in a Challenging Country."

## January 27, Noon Luncheon Meeting

Speaker: David J. Talbot, chief electrical inspector, City of Chicago.

Subject: "The New Chicago Electrical Code."

## January 29, Ladies Night Party

Speaker: Terry Glenn, service engineer.

Subject: "Around the World on the 'Brigatine Yankee.'" There will be dancing afterwards.

## February 2, Communications Section

Speaker: John F. Boyers, vice president, Magnecord, Inc., Chicago.

Subject: "Binaural Sound Recording and Reproduction."

### NOTICE

Plans are now being completed for the reactivation of the Consulting Engineers' Division. All members interested can attend a special meeting on January 20 at WSE headquarters where the subject will be fully discussed and the proposed plan explained. If you cannot attend, mail your comments to J. Earl Harrington, Executive-Secretary, Western Society of Engineers, 84 East Randolph St., Chicago, 1.

## At Puerto Ordaz, Venezuela

# Ore Handling and Crushing System

L. O. Millard

The ore handling system at Puerto Ordaz serves a most important function in Orinoco's over-all plans for delivering iron ore from Cerro Bolivar for blast furnace use. Essentially, it is a transfer station for unloading run-of-pit ore from mine cars, crushing and storing it on the ground, from which it is reclaimed and loaded into ocean ships as needed. The remote location of the plant and the magnitude and importance of the entire operation emphasized the necessity for equipment that would be dependable and economical to operate. Although the flow sheet is relatively simple, the high capacity and the different characteristics of the ore precluded direct comparison with existing installations as an aid to solving the most intriguing and challenging problems.

In the part of the system for unloading, crushing and bedding the ore into storage, all components are designed to handle as much as 6,000 gross tons per hour to meet the ultimate requirements of mining and shipping. However, as only one secondary crusher is being installed at this time, the dumping cycle and apron feeder are adjusted to provide a capacity of 3,000 tons per hour for the present.

The design of the reclaiming and shiploading portion of the system was influenced by future needs as well as physical and climatic conditions. Early shipments will be made largely in Liberties, Victories and other small ocean vessels. It is anticipated that special carriers of perhaps 40,000 to 50,000 tons capacity will be used for shipping in the future. In order to dispatch these ships quickly and economically, the design provides for two duplicate shiploaders and conveyor lines to load at future peak rates of 12,000 gross tons per hour. The initial installation includes one loader with its conveyor line from reclaim tunnels.

Extensive tests by drilling and tunneling indicated the equipment had to be capable of handling ore that at times might have a tendency to pack and bridge over openings like clay. For brevity in this paper, this type of material will be referred to as "sticky."

The behavior of the ore had to be considered carefully throughout every stage of the system. It was a particularly important factor in the problem of assuring a uniform flow at the unprecedented rate of 6,000 g.t.p.h. through hoppers, chutes, and transfers between conveyors. Each of these points was a potential source of havoc that could result from a build-up or packing of sticky ore when handled at nearly 2 tons per second. Also, the impact and destructive sand blast effect of hard, sharp material as discharged from high speed belt conveyors were major design considerations.

### Unloading, Crushing and Bedding Ore to Storage

Ore from the mine is received at Puerto Ordaz in cars having a capacity of 90 gross tons. Each car is uncoupled from train and drifted individually into a conventional retarder, where it is held until withdrawn by a barney haul. The loaded cars are fed into a single car rotary dumper, and are discharged at the rate of 67 cars per hour. The loaded car bumps the preceding empty car from the dumper and is stopped by track brakes in the dumper. The empty runs by gravity through a

Mr. Millard, assistant general sales manager, Link-Belt Company, presented this talk at the annual meeting, Construction Division, of the American Society of Civil Engineers, on October 21, 1953, in New York City.

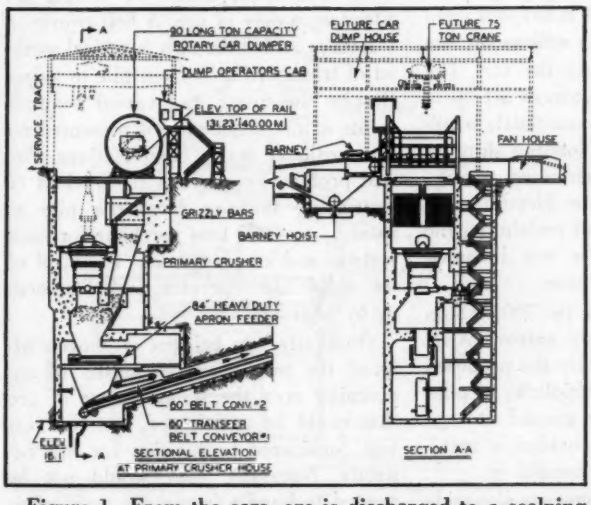


Figure 1. From the cars, ore is discharged to a scalping grizzly set with 9" openings.

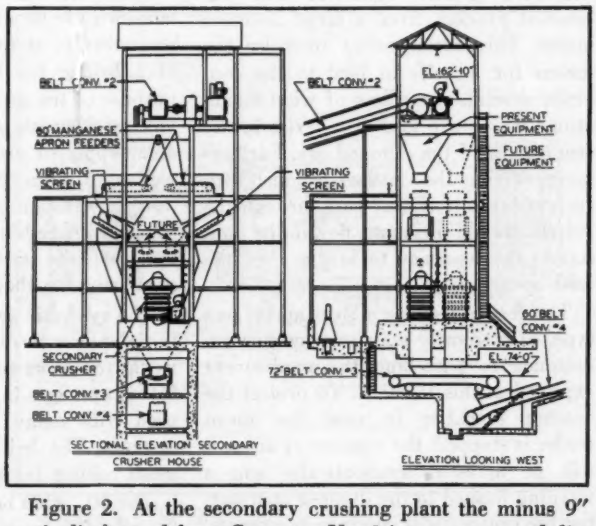


Figure 2. At the secondary crushing plant the minus 9" ore is discharged from Conveyor No. 2 into a surge and distribution chute.

kick-back to empty collecting track.

All functions of the barney and dumper are electrically interlocked and are controlled by one operator. He is so located that he can see the incoming and outgoing cars as well as the stone box above the primary crusher. Although the dumping cycle is much faster than for any existing dumper of this size, a careful study indicated that is is safe and practical, both mechanically and electrically. Also, for a reasonably intelligent and experienced operator, the cycle does not present any unusual problems of dexterity or fatigue.

From the cars, ore is discharged to a scalping grizzly set with 9″ openings (Fig. 1). The oversize flows to a stone box above a 60″ heavy duty, open bottom gyratory crusher. Undersize from the grizzly joins the minus 9″ crushed product beneath the crusher, where there is space for about 2½ carloads of ore. This volume provides surge for a uniform feed to the conveying system. Also, the resulting headroom assists in protecting the crusher eccentric.

The use of one 60″ primary crusher for an unloading capacity of 6,000 tons per hour is based on a crusher capacity of 3,000 tons per hour. Tests indicated that the ore will rarely contain more than 50 percent of material that will pass over the grizzly. Obviously, with more than 50 percent oversize, the crusher will limit the capacity that can be fed to the system.

One feeder is used to withdraw the combined grizzly undersize and the crushed product from a large common outlet. This arrangement provides the means for a uniform feed to the conveyor system, regardless of wide fluctuations which are known to exist in the size consist of the dumped ore. Furthermore, mixing the crushed product with such sticky ore as may pass through the grizzly should promote flowability and reduce the tendency to bridge over the feed opening.

The feeder itself is a steel apron pan type, of extremely massive construction, designed to withstand the punishment expected at this location. To protect the crusher eccentric in case the apron feeder is stopped, the rotation of dumper will be arrested automatically and a warning flashed to the dumper operator, but the crusher will continue to operate.

A system of 60″ wide belt conveyors is used to handle ore from primary crushing station to secondary and then on to storage at about 600 feet per minute. The main inclined Conveyor No. 2 from primary to secondary is equipped with a steel cord belt and is driven by a 1250 horsepower motor. To reduce wear on this expensive belt, a special transfer conveyor was installed beneath the apron feeder. Also, components of the system are protected against damage from tramp iron by a metal detector located near the foot end of Conveyor No. 2. Both of these safety devices will be described later.

At the secondary crushing plant (Fig. 2), the minus 9" ore is discharged from Conveyor No. 2 into a surge and distribution chute from which it is fed uniformly by manganese apron feeders to each of the four scalping screens ahead of crushers. Oversize from these screens is delivered to opposite sides of the crusher stone boxes for more effective crushing results. Space is provided between the screens for a future shuttle belt on which coarse ore may be withdrawn from the top decks of any or all of the screens.

The secondary crushing plant is designed to produce a final product, 85 percent of which will pass between bars spaced at 5″ clear openings. Maximum capacity is based on not more than 40 percent of plus 5″ material passing to the two 30″ by 70″ crushers. The latter are of the gyratory type, especially designed for secondary service.

Space limitations and topography determined the location of conveyors from secondary to storage, as well as the use of a bridge for bedding the ore. The purpose of the ground storage is to provide an adequate and immediately available supply of ore for loading ships as well as a surge between mine production and shipping. Some blending will occur from bedding and reclaiming the ore, but the system is not intended primarily for that purpose.

The available area for the 700,000-ton initial pile was relatively narrow. Also, it was too short to contain the proposed future tonnages in a multiplicity of piles used with many other ground storage systems. The bridge provided a maximum volume for these conditions.

The 60″ wide belt conveyor alongside the pile delivers to bridge belt conveyor by means of a special high tripper which is propelled by the bridge through a draw bar. The bridge itself has a span of 400 feet track centers and its structure and traversing mechanism follow conventional ore bridge construction.

### Reclaiming and Shiploading

A purely functional but perhaps over simplified approach to the problems of the Orinoco reclaiming and shiploading system is to consider it as the means for controlling the flow of ore from storage pile to waiting ships. This function in its simplest form is achieved at the docks of Upper Great Lakes ports, with their large bins or pockets, from which Mesabi ore is chuted directly into the holds of the boats. (Regardless of size, lake carriers are always called "boats.")

At Puerto Ordaz, practically every condition contrasted sharply with those in Duluth or Superior—except the requirement for dependable and fast operation. The system had to be capable of serving nearly every type of ocean vessel, including 40,000 to 50,000 ton ships not yet designed. The Orinoco River at dockside was known to rise and fall about 40 feet annually. Flexibility was required to fill irregularly spaced hatches selectively, to trim both fore-and-aft and 'thwartships, while avoiding the rigging characteristics of ocean ships. For these and other reasons it was decided that the cost of a bin system would be prohibitive and its operation impractical.

Ground storage was adopted as the most economical means of storing an adequate supply of ore. A belt conveyor system provided the only practical method of transporting it from pile to ships. Despite the many and varied requirements of the shiploader, it presented no extraordinary design complications. The real problems concerned the method of reclaiming the ore from the pile at rates up to 6000 tons per hour for each system, and keeping it under control of the shiploader operator over distances up to 3000 feet.

Obviously, ore bridges or shovels offered the most positive means of reclaiming even the stickiest type of ore that could be anticipated, but the cost was considered prohibitive for this capacity. Naturally, they would not be needed to handle frozen ore as is often the case in northern operations. A study of the shape and size of the pile indi-

cated that it could be reclaimed most economically by two tunnel conveyors. Sufficient clearance was provided for installing future conveyors large enough for serving two shiploaders. However, minimum shiploading time required assurance of a flow of ore through the tunnel openings that was more positive and dependable than conventional gates and feeders used for stone, coal and other free-flowing materials. To provide for dealing with any sticky type of ore that might be encountered, it was finally decided that flow could be maintained more dependably with a traveling rotary plow type of feeder than with other feeding devices (Fig.3).

The traveling rotary plow feeder has been used in Germany for many years and small units are in operation in this country for handling iron ore and sinter. It consists of a traveling carriage upon which are mounted horizontally rotating bladed arms which plow the ore from a continuous horizontal shelf into a collecting belt. At Puerto Ordaz each feeder is equipped with two rotors each about 11 feet in diameter. A short transfer belt is mounted on the traveling carriage to take the impact of ore discharged from shelf. Also, it is intended to assist in regulating the flow and to improve the loading conditions to the 48″-wide main tunnel belt conveyors. Two feeders serve one conveyor in each tunnel, and together have a normal maximum capacity of 3000 tons per hour. However, one can feed up to 2000 tons per hour in an emergency.

Each feeder is interlocked with the master control of the reclaiming system, and its functions are controlled by the shiploader operator. In addition, manual controls on each feeder provide for adjustment of travel and rotating speeds to synchronize the feeding rate of feeder with one half the carrying capacity of its tunnel belt through a range of speeds from 0 to about 500 f.p.m.

The rotary plow feeder has a number of advantages over other feeding devices for positively assuring a high capacity loading operation, among which are the following:

1. Feed opening is continuous for the entire length of each tunnel. This arrangement provides less support for the arching of ore than would a series of rectangular feed openings of practical size.

2. Arch support is partially undercut by the rotating blades, a feature which would require costly auxiliary devices for other types of feeders located beneath rectangular feed openings.

3. Entire feeder travels continuously back and forth along the shelf between predetermined limits. Increments of capacity losses are limited to the distance the feeder travels beneath material that has arched solidly above cutting range of rotor blades. Arching over the openings of other types of feeders usually results in a complete stoppage of flow until the arch is broken by poking or by using some other auxiliary means.

Ore from the two 48″-wide tunnel belts is transported by a system of 60″-wide belt conveyors to the traveling shiploader. Enroute samples are removed and processed in the sampling plant near the inshore end of the dock, and the weight of ore is recorded by weightometers in the same building. These operations alone could well provide material for a complete paper.

The shiploader (Fig. 4) is of necessity quite versatile to meet the conditions described previously. Ore from the long dock belt is received on a short 60″-wide transfer conveyor, from which it is discharged to the upper of two 72″-wide conveyors, both of which are mounted on a common pivoted boom. The lower shuttle conveyor may be extended to trim the hatch of largest vessel or retracted to clear the face of dock. The boom may be raised and lowered through an arc suitable for loading small ships at low water or the largest anticipated carriers at 40 ft. higher water level. Trucks on standard gauge tracks and the traversing mechanism are similar to those used for ore bridges. They are powered by direct current to provide a top speed of 200 f.p.m. for movement from hatch to hatch.

One of the most interesting problems of the entire project was encountered in the system of belt conveyors from reclaim tunnels to shiploader. It was

*(Continued on Page 10)*

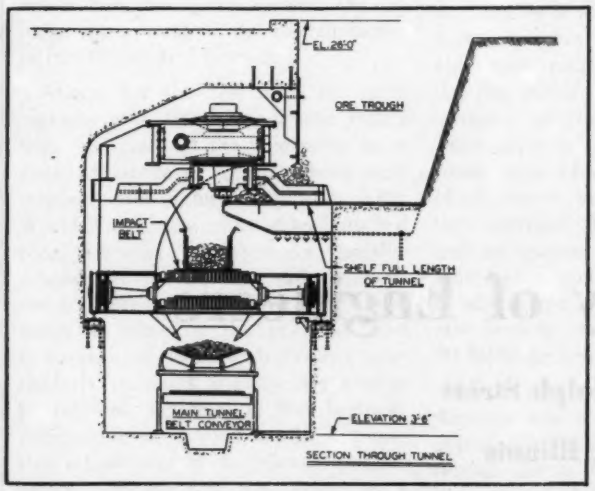


Figure 3. To deal with sticky ore, it was decided that flow could be maintained more dependably with a traveling rotary plow type of feeder.

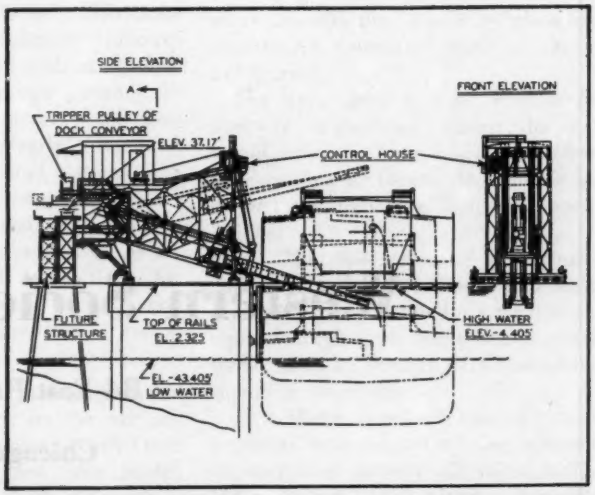


Figure 4. The shiploader is of necessity quite versatile to meet the conditions.

# Do your friend a favor—

## *Invite him to join WSE*

●

**Remember, the Society is as strong as its members collectively, and the more members, the stronger the Society.**

**Your friend will help make WSE stronger, and at the same time make you stronger in your profession.**

●

## Western Society of Engineers

**84 East Randolph Street**

**Chicago 1, Illinois**

# Limited Access Highways

By Charles M. Noble

The limited or controlled access highway when coupled with express highway features is the pinnacle in modern highway design. It is the safest and most efficient highway transportation medium so far developed. Why is this so, how did it happen to be developed, what it its record, what are its shortcomings, and where do we go from here?

At the close of the first World War, 35 years ago, virtually no paved rural road system existed in the United States. The League of American Wheelmen, an Association of bicyclists, was responsible for promoting the construction of the few rural paved roads in the Northeastern states, but the automotive vehicle sparked the Federal Aid Act of 1916. This was truly inspired legislation. It was of tremendous influence and a great stimulus to American road building. One of the prime objectives of the Act was to connect all County Seats with an *engineered* road, first by grading and draining and later, as money became available, paving sufficiently to provide some sort of surface that traffic could get over at all seasons of the year. These elementary roads stimulated automotive travel and created the demand for a mudless, dustless surface—in fact the modern pavement.

Almost for the first time, the rural highway was being engineered rather than "cut out" of the wilderness by a gang of laborers. At first there were relatively few highway engineers. After World War I when many states launched rural highway programs, a sizeable number of professional railway engineers entered the highway field inasmuch as some of the problems and techniques of locating highways, particularly in rough country are similar to railroad engineering. But highway engineering as related to the automotive vehicle was in its infancy and the engineer in this field was pioneering a new and unknown form of transportation. He faced unique and challenging problems chief of which was the technique of construction. It is a tribute to the U. S. Bureau of Public Roads and the State Highway Departments that these problems were attacked with a scientific approach and with vigor and intelligence. The almost unsurmountable problems of establishing adequate standards for construction materials, the setting up of testing and research laboratories and mastery of the techniques of construction were accomplished in an incredibly short time. Tribute must also be paid to the Highway Research Board, the Contractors, material producers and the Construction equipment industry.

By 1922 the States were building over 35,000 miles of highway per year and through the Twenties the highway program proved to be the largest construction job undertaken in the history of the world.

These roads were built in response to popular clamor from the general public plus the owners of twelve and a quarter million motor vehicles (1922); but funds were limited and the public expected a million dollars to go a long way and build a lot of roads. This meant that engineers of necessity followed old wagon roads and trails and where the line did go over new ground, the contours of the land were followed. Thus many of these early automotive roads were crooked and narrow with blind curves and choppy grades but they satisfied the need of the times, and the country was pulled out of the mud in an incredibly short time. Vehicular speed was not a factor generally because most motorists drove at 30 MPH or less.

Meanwhile, the mechanical genius of America was at work on the car and automobile manufacturers each year turned out a better and finer model. Soon the mechanical bugs were out of the car and the designers turned to more speed and power, providing luxury features and making automotive vehicles easier to drive. Thus in the middle thirties, when the big job of getting the country out of the mud was virtually complete and the entire nation was laced with a network of hard surfaced roads such as the world had never before seen, the highway and traffic engineers found themselves facing the speed and accident problem.

In 1935, an analysis of the speed habits of the country and the accident situation showed that the majority of drivers on the open road were driving above 45 MPH, that many cars were capable of speeds up to nearly 100 MPH, that there were 1,286,000 accidents in which 1,250,000 persons were injured and 36,369 persons killed producing a fatality rate of 15.9 per 100 million vehicle miles of travel. In that year, 26,230,000 cars and trucks were registered in the United States. Today there are approximately 54,000,000 vehicles registered, the national accident rate for 1952 was 1823 and the fatality rate 7.3 per 100 million vehicle miles.

The engineer realized that improvements in vehicle design were making many roads obsolete and that stock taking was necessary. An analysis of accidents showed they could be classified into certain groups or types, as shown in Figure 1.

The next question was, what could highway engineering design do that would reduce or have a favorable effect on curtailing accidents. An analysis indicated the following beneficial possibilities:

(a) The elimination of all highway and railway grade crossings would make it physically impossible for a right angle type of accident to occur due to cross traffic, thus 21 percent of all accidents should be eliminated.

(b) Many types of same-direction accidents were caused by the influence of oncoming opposite-direction traffic. If the divided (dual) highway principle were utilized, this type of causation should be eliminated.

Mr. Noble, chief engineer, New Jersey Turnpike Authority, presented this talk at the 41st National Safety Congress on October 22, 1953, in Chicago.

| Type of Accident | Percent of Total Accidents* |
|---|---|
| (1) Cross Traffic (Grade Crossings, Highway & Railway) | 21 |
| (2) Same Direction | 30 |
| (3) Head-On | 21 |
| (4) Fixed Object | 11 |
| (5) Pedestrian | 10 |
| (6) Miscellaneous | 7 |
| Total | 100% |

Figure 1

Furthermore, the use of curbs hampering lateral freedom affected such accidents because the motorist did not have an opportunity to dodge sidewise onto the shoulder to avoid a crash in case of an emergency. Wide, smooth, stabilized shoulders, level with the pavement, permitting lateral freedom, would have a favorable influence on same-direction accidents. Many same-direction accidents were caused at intersections by stopping of vehicles at traffic lights or slowing down or stopping to make a turn. If grade separations, divided or dualized roadways and wide, smooth, stable shoulders were utilized, it appeared certain the same-direction accidents would be materially reduced probably to the extent of 20 per cent of all accidents.

(c) The opposite-direction accident could be largely eliminated by the provision of a wide space separating opposite-direction traffic (dualization) possibly to the extent of accounting for the total of 21 per cent.

(d) If all fixed objects were removed for a reasonable distance from the pavement, the fixed-object accident could be largely prevented; but in order to be conservative, it was assumed that one-half of these accidents could be eliminated, namely five percent.

(e) In the case of pedestrians, if their presence was eliminated from motor areas, it was reasonable to assume that all but two percent of the total could be eliminated, namely eight percent.

Summarizing this 1935 analysis, it was reasoned that the use of known highway-design techniques would surely have a favorable influence on accidents and would in all probability account for the reduction of the following types and percentages of accidents: right angle, 21 percent; same-direction, 20 percent; opposite-direction, 21 percent; fixed object, six percent; pedestrian, eight percent; making a total of 76 percent. It was concluded therefore, that improved engineering techniques and design would have a pronouncedly favorable effect on accident reduction.

In addition to the above features, it was also evident that many accidents were caused by varying conditions on the highway which caught the motorist unaware, such as unexpected sharp curves, torturous alignment, narrow pavement and bridges, lack of sufficient sight or vision ahead, and steep grades. It was evident that the motorist had a right to expect uniform and consistent operating conditions. To combat those hazards, engineers recognized the necessity of establishing a "design speed" and designing for this speed, utilizing scientific laws of motion that reflected the dynamic power of the motor car and the reaction capabilities of the motorist. As a factor of safety, it was considered desirable to set the design speed greater than the posted speed to care for those operators who operated above the speed limit.

An analysis revealed that design speed affected the following features:

(1) Overall Width of Highway. (a) Median strip, width and treatment. (b) Shoulders, width and treatment. (c) Paved lane width.

(2) Sight Distance. (a) Vertically. (b) Horizontally. (c) Determination of proper braking friction factor and human reaction time for bringing the car under control.

(3) Minimum Radius for Horizontal Curvature.

(4) Rates of Super-elevation for Horizontal Curves. (a) Determination of proper friction factor for use in super-elevation (banking) design. (b) Correlation of super-elevation rate with requirements of slow and fast vehicles.

(5) Length of Spiral Curves and Super-elevation Runout.

(6) Length of Profile Tangents.

(7) Distance between Horizontal Curves.

(8) Spacing of Points of Access and Exit.

(9) Length of Acceleration and Deceleration Lanes at Points of Access and Exit.

(10) Design of Turnouts at Points of Exit.

(11) Signs. (a) Size of letters. (b) Maximum number of words in sign message. (c) Position. (d) Target value.

It has been demonstrated by actual experience that control of access is utterly essential in preserving the highway investment and retaining traffic efficiency and capacity. Time and again commercial mushroom roadside development has sprung up along uncontrolled rights of way and ruined modern highway improvements costing hundreds of thousands of dollars per mile, thus reducing a once splendid traffic artery to a status of little better than a city street. It has been shown that the controlled access express highway has a capacity as much as eight times that of a city street of comparable width.** Consequently, every effort should be made to preach the gospel of *controlled access* as the only way to preserve highway investment and avoid scrapping expensive highways and having to rebuild on additional and new rights of way at tremendous capital cost and loss in tax ratables. The country can not afford such wasteful measures and early enactment of controlled access legislation should be sought in those states not having such legislation.

Highway Capacity Studies** have demonstrated that design features have a pronounced effect on highway capacity. It is believed capacity requirements impose more severe limitations on geometric design features than mere design speed. Dynamic and human capacity will enable a speed greater on lightly travelled highways than drivers will accept under crowded traffic conditions. For example, the vehicle and the driver can negotiate a properly designed 1,000 foot radius curve at 60 MPH with relative ease under light traffic. As traffic increases, such a curve causes hesitancy by many drivers in passing or remaining parallel in lane, which in turn causes a "bunching" of

*Transactions of the American Society of Civil Engineers Vol. 65, No. 104 (1939), p. 474 (Arnold H. Vey)

**Highway Capacity Manual (Highway Research Board).

traffic to such effect that there is a loss in traffic capacity.

Because insufficient capacity is a great problem today and will continue to be so in the future as vehicle registrations increase, it is believed important to establish geometric design standards that reflect capacity factors as well as those associated with speed. The groundwork** for this objective has been laid but it is believed further exploration of the effect of horizontal curvature, spacing between horizontal curves, length of profile tangents, and nonpassing sight distances on dualized highway capacity would be fruitful.

Now let us look at the safety record of the controlled access expressway. One of the most recently completed controlled access expressways is the New Jersey Turnpike which contains all of the safety features and design advancements noted previously. This grade separated, dualized facility, 118 miles long, was opened to traffic successively starting November 5, 1951 and ending with the final section completed and opened on January 15, 1952. Because it is a toll facility where vehicles are checked in and out, and because it is policed with a special detachment of State Police, the mileage and accident records are unusually accurate.

In 1952 the accident rate on the Turnpike was 140 per 100 million vehicle miles, compared with the 1952 national rate of 1823. In other words, the New Jersey Turnpike accident rate was but 7.7 per cent of the national rate. Therefore, instead of but 76 per cent of the accidents being eliminated by engineering design as analyzed in the mid-thirties, actually 92 per cent of the accidents occurring on the countrywide system have been eliminated on the New Jersey Turnpike.

As a matter of fact, the record is better than indicated since the comparison is with the 1951 national record rather than the 1935 record. Since the year 1935, nationally there has been a substantial improvement in highway design standards, many miles of improved highway have been built, miles of dualized, grade separated and controlled access expressways put in service and the effects of national safety drives have been pronounced.

The fatality record on the other hand did not keep pace with the reduction in accidents. In 1935 the national fatality rate was 15.9 per 100 million vehicle miles while in 1952 it was 7.3. By contrast the fatality rate on the New Jersey Turnpike for 1952 was 6.11. It is therefore evident that the fatality problem on controlled access highways must be attacked with vigor and imagination. The Commissioners of the New Jersey Turnpike Authority are alert to this problem and are leaving no stone unturned in utilizing every feasible suggestion that promises favorable possibilities. As a result of these measures the fatality rate on the Turnpike for the first seven months of 1953 was reduced to 3.54.

| Number | Type of Accident | Total Killed | % of Total Killed |
|---|---|---|---|
| 17 | Rear End | 33 | 47.8 |
| 8 | Crossed Median | 10 | 14.5 |
| 5 | Hitchhiker or Unauthorized Pedestrian | 5 | 7.2 |
| 4 | Fixed Object | 6 | 8.7 |
| 10 | Ran Off the Road | 11 | 16.0 |
| 4 | Miscellaneous | 4 | 5.8 |
| 48 | Total | 69 | 100.0% |

Figure 2

An analysis of all the fatal accidents on the Turnpike since opening through July 31, 1953 is shown in Figure 2.

Of the fatal rear-end collision accidents, 53 per cent of the total involved motorists running into the back of trucks *at night* usually without any indication that the motorist applied his brakes. This indicates a lack of depth perception and it is possible that the non-uniformity of truck rear lighting may be at the bottom of these accidents.

Good work can be done by launching a national campaign for uniform, reliable and adequate rear lighting of trucks. It has been brought out that often the rear light candlepower on trucks is less than on passenger cars and the electrical connections are unreliable on some types of trucks. It should be simple to increase candlepower and provide a "tell tale" in the cab to notify the driver of light failure. Rear lights placed a standard height above the road of uniform width and brillance and located in such a position as to lessen soiling by mud and snow would be a real step forward in highway safety.

Some fatal accidents on the Turnpike may have been caused by drowsiness. There has been the charge also that the modern expressway is monotonous and induces sleepiness or inattention, although this charge appears based on popular speculation rather than on concrete facts. Therefore research may be desirable to establish the facts.

There has also been considerable comment in the press concerning driver hypnosis and some psychologists have accumulated data purporting to show that the modern highway induces hypnosis that dulls perception and reaction. It is not known whether these phenomena are merely day dreaming or whether the controlled access highway has properties that create a really hypnotic condition. At any rate, the removal of hazards, and the ease that the modern highway can be driven has created the impression of monotony and this feature is particularly commented on by truck drivers. It might appear that unless obvious hazards exist to excite the driver, he will not be sufficiently stimulated either to be alert or stay awake if tired. This is not to say that the cure could be worse than the bite, but here is an area for worthwhile research and imaginative thinking and suggests the possibility of developing measures for stimulating and exciting the driver to the point that the laws of self-preservation will operate. The new Committee on *Highway Safety Research of the National Research Council* may point the way to an approach to this problem. I consider the appointment of this Committee to be one of the most important steps taken in highway safety in recent years.

So far no highway or vehicle has been produced that eliminates the necessity for the driver to drive the car. The motorist must still apply good judgment, common courtesy, a sense of responsibility and know-how to the job of driving. Bumper driving, weaving in and out of traffic, passing on the right, driving too fast in bad weather, inattention, drowsiness and lack of driving skills are

*(Continued on Page 12)*

## Ore Handling

*(Continued from Page 5)*

necessary to transport a maximum tonnage in the least elapsed time, which required eliminating potential delays wherever possible. This involved such important design considerations as:

1. To maintain a dependable and reasonably uniform feed to the belt system.
2. To load the belts at the practical maximum cross-section without excessive spillage at transfers.
3. To operate the entire system as a unit despite its length and the number of conveyors involved.
4. The necessity for rather frequent starting and stopping while the loader moves from hatch to hatch.
5. The necessity for reduced capacity for trimming individual hatches.

As stated previously, the rotary plow feeders were adopted to provide the most dependable feed to the belt conveyor system from the tunnel openings. The use of direct current for the entire reclaiming system provided the most satisfactory solution to the other problems. It enabled all the units to be tied together electrically throughout the entire speed range and under the control of the shiploader operator. Thus, it reduced the cumulative time delays resulting from starting and stopping the various units in sequence. Sequence control is necessary with the use of A.C., and the loss of time for each start-stop or slowdown would have been appreciable.

However, the direct current hook-up required special consideration for this relatively long and heavily loaded system of belt conveyors. When two or more consecutive belts are started simultaneously, the speed of the foot end of the leading belt is less than the speed of the belt over the head pulley of preceding conveyor. This is due to the stretch of standard fabric belts resulting from the accelerating stresses. Obviously, until the two belts reach the same speed, the leading belt receives more than its normal cross-sectional load of material from the preceding higher speed belt, and spillage may result. To overcome this condition, steel cord type of belts were used in the reclaiming system as they provide minimum stretch within the design limits.

Throughout the entire project safety of personnel and protection of equipment were considered carefully. One of the most important devices for protecting and increasing tonnage life expectancy of the various main belts is the use of transfer conveyors. They consist of short belt conveyors equipped with relatively small head pulleys, rubber impact supporting idlers and belts especially designed for impact and abrasion. All have vertical skirt plates with virtually no sloping chutes. In fact, they actually take the place of chutes. Provision is made for changing the belt quickly. These transfer conveyors are designed to perform the following functions:

1. To provide a positive means of changing the direction of the tremendous flow of ore at 90 degree transfers without the use of chutes.
2. To assure dependable transfer of ore that might otherwise build up in the valley angles of ordinary sloping chutes.
3. To reduce wear on the main belt beneath the transfer by discharging sharp abrasive ore at a speed near the main belt speed and with the shortest practical drop.

The metal detector used at the foot end of primary belt Conveyor No. 2 serves to protect that expensive belt when a magnetic object is conveyed into its field. At that time, it will provide the impulse for the following functions:

1. Mark the belt at approximate location of metal object.
2. Sound a warning siren.
3. Stop forward rotation of the car dumper.
4. Stop the feeder beneath primary crusher.
5. Stop main primary Conveyor No. 2 when the object is within a few feet of the head end.
6. Permit crusher to continue operating.

The entire project required extremely careful planning and scheduling. The field erection stage received particular consideration due to the size and complex nature of the equipment. The diversity of crafts involved, the location of the plant site, and the short time allowable for installation precluded any extensive training program for native labor. As a result, it was necessary to import a high percentage of North American craftsmen with the attendant cost of their transportation, housing, insurance, etc. Obviously, it was necessary to utilize every available manhour effectively, not only to meet construction cost estimates but to maintain high morale within the labor force.

Every phase of design, manufacture and erection was carefully analyzed and a time schedule was established covering each operation as well as the delivery of each purchased component. The over-all picture was set up in a

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# Mechanical Design Considered

The possibilities for creative mechanical design, a new departure in engineering thought, were considered from the standpoint of both education and industry on November 30 at the annual meeting of The American Society of Mechanical Engineers in New York.

Challenging the old idea that ingenuity is an inborn quality and only the genius can create, Professor George B. DuBois of the Department of Machine Design at Cornell University, stated emphatically that ingenuity can be taught. Five years' experience with a new course at Cornell, one third of which takes the creative approach against two thirds fundamental design methods, bears out his contention. "Most problems do not require genius—just a little actual work with a pencil," he said.

By making the course elective the instructors attract only students with some interest in creative design and the problem is only to improve their ingenuity. "We have had no trouble with lack of ingenuity in our students. On the contrary, their work has sometimes been amazing," Professor DuBois said.

Referring to the application of this training when the student enters industry, he stated, "To most production workers changes in design are distasteful. Few people realize that there is a time when improvement changes are welcome, and should even be sought. This is before the production tooling has been made, and preferably while the layout design is in progress. The realization is growing that more time, and more thorough work on design development, can reduce the number and cost of changes required later."

"The approach to ingenuity is a field almost untouched. It is like a course in geometry would be with no textbook of accepted theorems," he explained. At Cornell a set of mimeographed notes is being built up as a text for the course. Students are supplied with illustrated examples of various principles. In their course they are encouraged to refer to these examples to find improvements of their own for designs which are intended to solve the engineering problems presented to them.

The problem of obtaining a new idea can be one of seeking improvement for a known or unsatisfactory method, or of seeking a solution where there has been none, Professor DuBois pointed out. "The actual problem of finding a design solution is often less difficult than finding a solution that is economically feasible, or one that is suited to the space and weight limitations. The recognition of a need with an adequate market is perhaps the hardest step of all. The true inventor combines the recognition of a need with a practical solution for it," he said.

At the same session Maurice Nelles of Borg-Warner Central Research Laboratory, Bellwood, Ill., stated, "Creativeness in engineering is one of the important keys to technical and sociological progress.

Usually engineers have had goals set for them—a bridge to be built, or a highway to be constructed between two points, or a new plant to utilize a new process, he pointed out. As a rule the engineer starts out with at least one available way to achieve these goals. "This way may be the poorest or the best, but the engineer will not know which it is unless he has deliberately created all the other possible bridges, products or arrangements," he said.

Nelles suggested several steps as an engineer's check list for reaching a valid goal, among them the study of all the needs in connection with the problem, and a critical study of existing products or equipment with an eye to how they can be improved.

The next step in deliberate creativeness is to make preliminary designs which help the engineer to visualize and add or discard parts, mentally; simple models, perhaps of paper; laboratory experiments; reading everything available in the field; talking over the problem—often with someone to whom it must be explained in very simple terms; trying opposites—"If something has traditionally been made from a hard substance, try a soft one;" and trying limits—"Under what conditions will it break immediately and under what conditions will it run forever?"

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chart and maintained for reviewing progress from day to day. The extensive analysis made for the field erection period was particularly helpful when it became necessary to reduce the completion time from twenty-seven months to approximately twenty months midway during the prosecution of the contract. Splendid cooperation by all participants enabled this to be done.

It is difficult to cover all phases of a project of this magnitude in one brief paper. Any one of several operations and pieces of equipment contains enough material for individual papers.

The final designs are the result of cooperation between the owner and his engineers, and the contractor and his subcontractors. Contributions were made by all branches of the engineering profession, civil, mining, mechanical, electrical and industrial. Operating results will be available after the plant goes into operation in January, 1954. At that time this plant will do its job as a most important link in making Cerro Bolivar ore available to the blast furnaces of America and the world.


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## Highways

*(Continued from Page 9)*

sure roads to disaster in the heavy traffic of today.

A continuing national campaign stressing the life saving necessity of constant check and assurance that tires, front wheel suspension, steering, brakes and lighting are in first class condition before venturing on the open road will prove a real life saver. And the deadly menace of driving while sleepy or inattentive should be brought home to every driver. I feel sure that if the hazards of hitchhiking were brought home to parents, there would be fewer boys on the highway flirting with death.

These are the great killers on the modern highway.

The engineer is constantly seeking to improve highway safety by research and adjusting design to include every proven safety device in the construction of modern highway. He is not resting on his laurels but is constantly on the alert to develop new and better designs. But it should be recognized that the driver must still drive the car. His life will depend on how well he does his job.

## *Men Seek Answer To Incentive Problem*

What can be done to solve wage incentive problems?

More than 200 managers from business and industry searched for solutions to the problems when they attended a two-day Wage Incentives Workshop conference on Dec. 3 and 4, at Illinois Institute of Technology, Chicago.

The IIT department of industrial engineering sponsored the conference in cooperation with the Chicago chapters of the American Institute of Industrial Engineers, Industrial Management Society, and Society for the Advancement of Management.

Anthony Doria, international secretary-treasurer, United Auto Workers, American Federation of Labor, Milwaukee, Wis., discussed "Labor Looks at Wage Incentives." He was introduced by John D. Larkin, dean of liberal studies at IIT.

James F. Lincoln, president of the Lincoln Electric Company, Cleveland, Ohio, offered management's views. Lincoln, who was introduced by Dr. John T. Rettaliata, MWSE, Illinois Tech president, discussed "Management Looks at Wage Incentives."

The workshop technique was used to help participants solve wage incentive problems. University specialists served as chairmen of the various sessions, while specialists from business and industry were panelists.

Several other IIT men participated in the conference, sessions of which were held in the Metallurgical and Chemical Engineering building on the Institute campus.

M. D. Kilbridge, director of the industrial engineering department, was chairman of a workshop session on incentive management. Dr. Pearce Davis, chairman of the department of business and economics, was chairman of a session on union policy and wage incentive methods. Other chairmen were from Northwestern and Purdue universities and Michigan State college.

Robert J. Parden, associate professor of industrial engineering, was chairman of the opening general session at which Dr. Ralph G. Owens, MWSE, dean of engineering, spoke.


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# Speaks on Human Resource Use

"The determination of policies respecting the development and utilization of our human resources must not become the private reserve of organized groups which are primarily and understandably concerned with protecting and advancing the interests of their members," declared James D. Zellerbach, Chairman of the National Manpower Council in opening the five-day conference, called by the Council, on how to improve utilization of the country's scientific and professional manpower.

Sixty-six leaders in the fields of engineering, medicine, education, science, industry, government, and the armed services from all over the United States took part in the Conference held in October on Columbia University's Harriman Campus at Harriman, New York.

The Conference sought practical methods of carrying out the recent recommendations on manpower utilization by the National Manpower Council in its book, *A Policy for Scientific and Professional Manpower.* This study, published by the Columbia University Press, was presented by Council members to the President at the White House on May 18. President Eisenhower has remained actively interested in the Council's work since its establishment at Columbia's Graduate School of Business in 1951 when he was president of the University.

In addressing the Conference Zellerbach said that an understandable failure to grasp the interrelatedness of policies for scientific and professional manpower and a public indifference to the significance of these policies "could combine to cause serious injury to our national well-being and strength." Zellerbach is president of the Crown Zellerbach Corporation, San Francisco, and an alternate delegate to the General Assembly of the United Nations.

Kenneth E. Boulding, professor of Economics at the University of Michigan, gave the Conference "An Economist's View of the Manpower Concept." He warned against seeking better utilization through governmental allocation measures or other steps which involve undesirable interference with the workings of the market economy. "There is no such thing as manpower save as a hot abstraction to be handled with long tongs," said Boulding. He urged the participants to think of utilization problems not in terms of "manpower," but of "men"—of "men in their infinite variety and sacredness, and their complex personalities and unfolding desires."

Frank Pace, Jr., former secretary of the Army and now executive vice-president of the General Dynamics Corporation, spoke on "Manpower Utilization From the Point of View of Top Management." Drawing on his experience as director of the budget, secretary of the Army, and in business, Pace illustrated the gains that can be made through "a genuine willingness on the part of management to venture into the experimental areas of manpower utilization." He pointed out that "seemingly inflexible principles which are applied to the management of men have got to yield to social and political pressures from time to time." He noted that significant improvements in utilization had been made possible by the policy of racial integration in the armed services, and he stressed the unique role of leadership in manpower utilization.

"Leadership," said Pace, "is that quality that lifts men and women toward whom one has responsibility out of their ordinary selves and permits them to accomplish in their fields more than they could if the leader were not there to impose his personality upon them. Of all the qualities which go into leadership, probably the most important is the capacity to command instinctive respect. But in order to command instinctive respect, one must have qualities of integrity, self-confidence, and acumen."

In additon to general sessions in which all participants joined, the Conference program provided for meetings by three working groups in the fields of engineering, medical and teaching personnel.

The proceedings of the entire Conference will be published by Columbia University Press early this year.

The engineering group was under the chairmanship of Frank W. Pierce, a director of the Standard Oil Company of New Jersey and a member of the National Manpower Council. George M. Maverick, director of the Employee Relations Department of Standard Oil Development Company opened the meetings of this group with a paper on the utilization of engineers and supporting technical personnel.

The findings of the engineering

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group, reported to the Conference as a whole, noted that improved utilization can be defined as any step which increases the quantity or quality of goods and services produced with given amounts of capital, using the same number of technological personnel, or, alternatively, as any step which maintains a given level of output in terms of quantity and quality, with a smaller number of such personnel.

The engineering group agreed:

1. The first step must be to make more effective utilization the focus of genuine and continuing attention at all levels of an enterprise.

2. If improved utilization begins at any one point, that point is improved training, not only in the colleges and on the job, but also in the elementary and secondary schools.

3. Much more has to be learned about the jobs which engineers and related supporting personnel are doing in order to reassign duties among different kinds of technical personnel.

4. Engineers have to have the best tools, instruments, and supporting personnel, if they are to make efficient use of their training and talents.

5. Improved utilization requires effective communication from management to engineering and related personnel about the objectives of their work. Moreover, since the actual changes in utilization take place well below the level of top management, effective communication upward is also essential.

6. Changes in the organization of enterprises can open up new possibilities for the better utilization of personnel. Too much organization may prevent necessary freedom in the allocation of effort, while too little organization may result in duplication, lack of proper priority, and unwise allocation of personnel to projects.

7. Improved utilization can also be achieved by keeping technologically trained people at the technological jobs for which they are best fitted through incentives in the form of status, recognition, and money rewards which are generally associated with jobs in management and sales.

8. Utilization can be improved through recognition of the fact that an individual's effectiveness and interest on the job is affected by many things outside of his work.

9. Attempts to improve utilization must always take into account normal human resistance to changes in the set-up which people know.

10. Utilization can be improved by management, not only by calling upon the manifest capacities of engineering personnel, but also by making an effort to develop their potential capacities through imaginative assignment and training.

11. Efforts to improve utilization must distinguish among what can be accomplished to secure immediate gains, what may yield results only after some investment of time and money, and what changes are fundamental and long range in character.

12. Improved utilization is achieved not through any single device, but by the use of many related measures.


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# Predicts Era of the Heliport

The time is coming when every Post Office roof in our large cities will have heliport potentialities, Charles Froesch, vice president, engineering, of Eastern Air Lines, ventured in a paper presented at the convention on Oct. 22 in New York of the American Society of Civil Engineers.

He declared it to seem feasible in New York "to use the roof of a building having the size of a city block, if the approach paths are clear" and that "the topography of New York suggests the spanning of steamship docks as suitable locations." Froesch also indicated the Chicago lakefront for amphibious helicopter service.

Foreseeing the introduction of commercial helicopter transports, Froesch said this would produce a profound change in local patterns. He explained:

"This may happen in three stages, the first being what we have today, using three 10-passenger machines, as exemplified by Los Angeles Airways, Helicopter Air Service of Chicago, and New York Airways. These three pioneers deserve considerable credit for forethought.

"The second phase may see operation of from 30 to 50-passenger helicopters. These will be commercial versions of present military designs. They will serve to accumulate operational experience in trunkline service and establish a sound basis for new designs.

"The third phase will be the integration of improved helicopters in all local schedule operations as feeders to trunkline stations and transferring to long range aircraft. It is likely this phase may occur before the next 15 years."

Froesch said "it is conceivable that the helicopter, or, perhaps, the Convertiplane, when practical machines are developed, eventually may replace our present twin-engine aircraft in local schedule operation." Recent rapid progress in helicopter design to meet military requirements "can be used to good advantage to create commercial helicopter transports of satisfactory characteristics," he said. He went on, "Many cities on trunklines deserve air service but cannot afford expensive airport installations due to their size or location."

Froesch pointed out that the helicopter is essentially a short-range vehicle of relatively slow speed compared with present-day airliners. He commented that "as a matter of national defense, the helicopter has no peer when ground installations, such as rail terminals, airports and bridges have been destroyed." He stressed the ability to operate in and out of very small areas and the slow speed as major advantages for taxi service, commuter service and local schedule operation on trunkline service.

Citing an interim report of the Committee on Rotocraft of the Air Transport Association outlining helicopter transport specifications for the guidance of manufacturers, Froesch said:

"If we start with the promise that any helicopter used by the airlines is eventually to provide a replacement for currently-used twin-engine equipment for local schedule operation and extension of services to other smaller cities, we should not contemplate any size less than 35 to 40 passengers and perhaps not more than 45 to 50. Thus, the design payload should not be less than 7,000 pounds and up to 10,000, the size of the average interurban bus.

"It should have a minimum range of 250 to 300 miles with maximum payload and one-half hour fuel reserve. The fuel reserve yardstick to be used for fixed wing aircraft does not apply any more because of the low landing speeds of the helicopter which permit much closer alternates."

Cruising speed was suggested at a minimum of 160 miles an hour and "it should be an all-weather helicopter, able to furnish the same type of service as now supplied by twin-engine fixed wing aircraft." One set of specifications indicated a cabin arrangement of four abreast in non-reclinable seats, light baggage rack, one lavatory and one snack bar. "The operating cost per seat mile shall not exceed that of present twin-engine aircraft for comparable distances between stops," it was proposed.

Stating that "a precise delineation of helicopter size must rest on the availability of power plants," Mr. Froesch went on to say:

"It is fortunate that engines are available which fall within the range of the passenger capacities I have cited and while the first production lot of helicopter transports probably will be powered with piston engines, their substitution with turbine engines is conceivable, but it will depend on the rate of progress made with the development of turbine propeller driven engines."

On heliport prospects, Froesch said:

"The ability of the helicopter to climb and descend almost vertically permits the use of landing facilities of small size when compared to airports.

"The ideal heliport location is, one which can generate to maximum traffic potential, whether it be in the center of a business district or adjacent to a large residential area.

"Nevertheless, safety of operation must rule over all other considerations. This may eliminate the consideration of heliports within large cities until such time as operating techniques and field size limitations can be thoroughly explored, always keeping in mind, however, that the ultimate goal is the operation of transport helicopters from any

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available small size downtown location areas, whether they be building roof tops, clearings, or dock decks.

"Within the limits of our present knowledge and the required level of safety for passenger operations, it appears that a twin-engine helicopter could operate from a minimum size heliport, approximately three times the maximum dimension of such helicopter. For the helicopters presently foreseen, the landing pad area should be approximately 400 feet by 250 feet.

"To begin with, and to allow for the suitable development of instrument take-off and landing techniques, additional minimum areas should be of the order of 250 by 400 to 600 feet. This would mean a total cleared area of approximately 250 by 800 to 1000 feet. It is expected that, as flight procedures develop and proper instrument landing aids become available, safe operations can be conducted into the minimum area of 250 by 400 feet without the over-run.

"Due to its newness, heliport design insofar as layout and location presents a fascinating problem to the city planner and a challenge to Architect and engineer.

"One of the most important problems facing the helicopter engineer and the acceptance of the helicopter by the air traveler is the question of noise.

"The noise level of a busy street can be as high as 80 decibels and that of the average street, 50 decibels. It is felt that the maximum noise level of 70 to 75 decibels should not be objectionable at a distance of 500 feet. This is a problem which will undoubtedly tax the ingenuity of the designer, but it must be solved.

"Another is that of communications. In bad weather, clearance to land at the next heliport will have to be obtained before departure because of the short flight distances expected in service. Also, instrument landing systems will have to be developed. Unless regularity of schedule can be accomplished, progress will be slow.

In view of the small size of in-town heliports, passenger traffic must be expedited in the least possible time. Dispatching and traffic control must be fast and accurate as, unlike at an airport, it will be impossible to park a large number of helicopters on a building roof. Arrival and departure must be expedited in the least possible time.

As the helicopter will not operate over the weather often, serious consideration must be given to the icing problem by the designer. This applies to engine as well as rotor system and cockpit windshield.

The structural integrity of the blade rotor system and its drive must be just as foolproof as that of the wings of an airplane so that in case of engine failure, safe autorotation can be used to effect a safe landing."

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# Crerar Library

## News and Notes

Recently prepared by Research Information Service is a brochure entitled "Specimen Pages of Library Research Reports." Prospective clients are usually interested in the various types of reports obtainable from R.I.S., and the new pamphlet includes samples of an author-title bibliography, annotated bibliography, informative abstracts, current literature reports, translations, and pages from various R.I.S. publications. Government agencies, industrial organizations, and others interested in having library research done for them may obtain copies on request.

* * *

"Great Scientists of the 20th Century" is the subject of a new display to be maintained at the north end of the Library entrance lobby. Featuring portraits and explanatory titles, the exhibit was initiated during December with a fine study of Albert Einstein. This photograph and the January portrait of Vannevar Bush were donated to the Crerar portrait collection by the world famous photographer, Yousuf Karsh, of Ottawa.

* * *

Regular members of W.S.E. need no guideposts to Crerar; however, the visitor passing through the Society's newly redecorated lobby will find a neatly illuminated sign to direct him into the Library building, should his yen be for research or leisure reading.

* * *

With the assistance of a grant from the Rockefeller Foundation, Crerar undertook in 1953 the preparation of a manual on the construction of a classified library catalog. Such a catalog differs considerably from the conventional library catalog, as users of Crerar have reason to know, in its arrangement of subjects according to a decimal number subject classification instead of an alphabetical file. The preliminary manual has now been completed, and the procedures suggested therein will be tested in Crerar's own cataloging department. When criticisms have been received and needed revisions made, a regular edition of the manual will be printed and made available to technical librarians and other interested persons.

* * *

One of the factors making possible Crerar's extensive resources of scientific literature has been the backing of the Chicago Chemical Library Foundation. At its recent annual budget meeting, C.C.L.F. reviewed expenditures for 1952-53, amounting to over $4,000 for current subscriptions and back files of periodicals, and nearly $700 for books. A budget for 1953-54 of $5,000 was approved by the Trustees of this or-

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ganization backed by chemists and chemical industries. Crerar's unsurpassed collections in chemistry are traceable to a large extent to this generous support.

## The Smashed Atom May Yield Energy

A new source of energy may lie in the particles of a smashed atom, according to Dr. William E. Bennett, professor of physics at Illinois Institute of Technology, Chicago.

The possibility was suggested Nov. 18 by Dr. Bennett, who gave the second address in a series of eight monthly lectures being offered at IIT for high school science teachers.

Dr. Bennett explained that less than one-tenth of one per cent of an atom's mass is converted into atomic energy in an uranium explosion. To make use of the rest, he said it would be necessary to find a method of breaking down the nuclear particles.

To do this, machines of very high voltage must be used to learn more about the properties of these particles, Dr. Bennett asserted.

Speculating that this may be another solution to the problem of finding a new source of energy, he stressed that all possibilities should be investigated.

Scientists have predicted that sources of coal and oil will be depleted in about a century and sources of uranium in about two centuries. Some scientists see a new source of energy in the harnessing of the sun's energy.

"Perhaps in a few hundred years' time, it may be possible to answer the question of whether nuclear fuels can be completely burned in some type of reaction very different from the one we know today," Dr. Bennett stated.

Discussing "Nuclear Bombardment," Dr. Bennett said atom-smashing machines first were used in nuclear experiments in 1932. He displayed a model of the Van de Graaf machine, the commonest type of atom-smashing machine.

This machine is the most-used type, he explained, because it requires the least expenditure of time and money to operate, it has a precisely defined voltage, and the voltage can be varied with comparative ease.

## *Urge Full-time Specialist Use*

Employment by industry of full-time cost reduction co-ordinators was called "a necessity" to any successful program undertaken to reduce overhead and expenses by H. N. Meixner, Engineering Department, E. I. duPont de Nemours and Company, at the annual meeting of The American Society of Mechanical Engineers on Dec. 3 in New York. He suggested at least one such person for each 100 employees.

"The coordinator, who is not involved in other duties, should be adept in removing obstacles, showing others how to remove them or if he cannot accomplish this, putting the information in the hands of management," Meixner explained.

"Training men to cut costs consists of establishing the need and desire for such activity, and then providing a climate in which their ingenuity can flourish," he said. "Like most things, cost reduction comes easily if you work at it hard enough.

"Enthusiasm, management backing, and follow-up can never be slackened if training for cost reduction is expected to continue to gain ground. Properly handled, such a program can be a powerful morale builder. Employees can be expected to take real pride in their cost reduction accomplishments, the same as in other phases of their jobs."

Meixner pointed out that special rewards and incentives prove an important factor in getting employees to want to cut costs. Employees should be brought to realize that in addition to the specific monetary awards they may receive, their ideas may demonstrate unsuspected abilities and talent which can lead to promotion.

Another technique is to provide competition. This may be done, he said, by establishing group goals for anticipated cost reduction over a period of time and comparing performance of separate groups with respect to percentage of goal that they are able to accomplish. Another method to maintain interest is the use of publicity and requiring periodic reports of progress and accomplishment.

After establishing the desire to cut costs, Meixner said that the next major step is to assist employees in learning how to do it.

"Sometimes this is done by divorcing individuals from their regular assignment for the period of time during which they devote all of their efforts to cost reduction activities," he continued.

"Rotating personnel in such a position not only provides the help necessary in carrying out such a program, but also is of considerable value when such individuals return to their regular duties. Specialized training for each group of persons with respect to how to do their job better emphasizes cost reduction.

Other training must be provided in specific aspects of the cost reduction phases of the work such as: how to prepare improvement suggestions, how to evaluate improvements including determination of savings, and how to explain and get the improvement placed into effect. Another type of training mentioned by Meixner was that of work simplification.

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# WSE Applications

In accordance with the By-Laws of the Western Society of Engineers, the following names of applicants are being submitted to the Admissions committee for examination as to their qualifications for admission to membership into the Society in the various grades, i.e., Student, Associate, Member, Affiliate, etc. All applicants must meet the highest standards of character and professionalism in order to qualify for admissions, and each member of the Society should be alert to his responsibility to assist the Admissions committee in establishing that these standards are met. Any member of the Society, therefore, who has information relative to the qualifications or fitness of any of the applicants listed below, should inform the Secretary's office. The Secretary's office is located at 84 East Randolph Street. The telephone number is RAndolph 6-1736.

68-53 Elmer G. Norell, Electrical Engineer & Partner, Sargent & Lundy, 140 S. Dearborn St.

69-53 Bonnell H. Allen, Manager-Chicago Office, Engineering Societies Personnel Service, Inc., 84 E. Randolph St.

70-53 Lester Crown, Vice President & Chemical Engineer, Marblehead Lime Co., 300 W. Washington St.

71-53 George A. Crosby, Assist. Chief Development Engineer, Signode Steel Strapping Co., 2600 N. Western Av.

72-53 Lincoln S. Gifford, Chief Plant Engineer, Signode Steel Strapping Co., 2600 N. Western Av.

73-53 Loman O. Green, Quality Engineer, Signode Steel Strapping Co., 2600 N. Western Av.

74-53 Hollinshead T. Martin, Director of Engineering & Research, Signode Steel Strapping Co., 2600 N. Western Av.

75-53 Charles G. Grove, Chief Engineer—Western Region, Pennsylvania Railroad Company, Union Station.

76-53 William G. Powrie, Chief Engineer, Chicago, Milwaukee, St. Paul & Pacific Railroad, Union Station.

77-53 Norman L. Wise, Assistant Chief Engineer, Johnson & Higgins, 231 S. LaSalle St.

78-53 Howard E. Anderson, President, H. E. Anderson Heating Corp., 3519 Elston Av.

79-53 Linas H. Brown, Chief Municipal Dept., DeLeuw, Cather & Co., 150 N. Wacker Dr.

80-53 Bertold E. Weinberg, Structural Designer, Frank J. Kornacker & Assoc., 53 W. Jackson Blvd.

81-53 Joseph F. Koenen, Engineer, Soil Testing Services, Inc., 3529 N. Cicero Av.

82-53 Gustave E. Caparros, Project Engineer, Construction Aggregates Corp., 33 N. LaSalle St.

83-53 Kearney E. Harmas, Jr., 820 Carrolton Blvd., West Lafayette, Indiana — attending Purdue University.

84-53 Robert L. Novak, Engineer, Soil Testing Services, Inc., 3529 N. Cicero Av.

85-53 Charles J. Poppe (Rein.), Project Engineer, Construction Aggregates Corp., 33 N. LaSalle St.

86-53 Russell T. Purdy, General Supt. of Power Supply, Commonwealth Edison Co., 72 W. Adams St.

87-53 Henry Crown, Chairman of the Board, Material Service Corp., 300 W. Washington St.

88-53 Walter A. Barry, Jr. Traffic Engineer, DeLeuw, Cather & Co., 150 N. Wacker Dr.

89-53 Rene A. Cooper, Estimator & Engineer, The Asbestos & Magnesia Materials Co., 2614 N. Clybourn Av.

90-53 Robert J. Kelly, Supt. of Parking, City of Chicago, 225 N. Wabash Av.


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## Search for Petroleum Aided by Gamma Rays

New developments in the field of rock strata identification were outlined Dec. 11 to a field trip group of the National Petroleum association touring the Armour Research Foundation in Chicago.

Leonard Reiffel, supervisor of nuclear physics at the Foundation, was one of ten Foundation staffers to unfold a story of teamwork leading to progress in the petroleum field. He spoke on gamma-ray well logging as part of his department's work in the field.

Gamma-ray well logging is the process of examining radioactivity at various depths in a well in order to identify the rock strata. The commonly accepted methods have measured only the amount of activity, but Reiffel described the Foundation's method as measuring the quality of activity as well by the use of a scintillation counter.

The combination of quantity plus quality aids the users of such equipment to determine the likelihood of oil deposits.

Other speeches delivered before the NPA group included descriptions of the work being done by the Foundation's chemistry, heat-power, metals, ceramics and minerals, and physics departments.

Topics covered by addresses at the conference included Electronic Instrumentation, Petroleum Exploration and Well Drilling, and Noise Reduction in Refinery Equipment.

## Indian Foundries Make Great Gains

Spectacular production increases have been achieved by the foundries of India in the last two years through the work of a Chicago research and development organization.

A foundry expert from Armour Research Foundation of Illinois Institute of Technology recently returned to the United States after a 20-month assignment in India. He is John F. Schnur, technologist for the Foundation's International department, who traveled throughout that country demonstrating modern foundry techniques.

By adopting these modern practices, Indian foundries were able to increase their production as much as 400 per cent at no additional expense in new equipment.

Schnur visited and worked in about 30 different foundries—from the smallest to the largest—throughout India. He spent from one week to two months at each plant.

The ARF technologist estimated he traveled 40,000 miles in India. Some of these miles were by elephant-back, when he went into the hills looking for molding sand.

Lack of a good, natural bonded sand was one of the problems which hindered India's foundries, Schnur said. Available sands had to be mixed in different proportions in each locality. The country hopes eventually to establish sand conditioning plants to overcome this problem, he said.

In addition to recommending the best possible sand mixture for each plant, Schnur's work was in two major areas: helping the foundries improve their pattern-making and teaching them modern molding methods.

Schnur's assignment in India was one phase of several Far East and Asian projects being conducted by ARF's International department as part of the U.S. Point IV program.

He will return to India in February to begin a new phase of the work. His task then will be to establish a training center for foundrymen at the Indian Institute of Technology in Kharagpur, about 75 miles from Calcutta.

Schnur said he looks forward to his new assignment because he believes it will be more beneficial in the long run than spot assistance to individual companies. It will strike at the root of India's industrial development problem—lack of the skilled engineers and technicians who are essential to a country expanding its economy.

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## *On Training—* Letters from Leaders

**In the last issue of Midwest Engineer we published another of about thirty letters received from leaders of Chicago-area firms concerning shortcomings noted in the engineers in their employ. Many of the letters also suggested what the engineers should do to correct their deficiencies.**

***Significantly, the engineer's technical training is generally considered adequate. In the broad area of Human Relations, however, engineers seem often to be "under achievers," according to the viewpoint of the industrial leaders as reflected in their letters.***

**We are printing another of these letters in this issue, as we shall do in future issues. Although the letters may be of greatest value to the younger engineers, we hope that all of the engineers who read them will benefit.**

***Here, then, is the next letter:***

Dear Mr. Becker:

Your letter to Mr. ..... has been referred to the writer.

Being an engineering graduate, I feel at liberty to discuss some of the characteristics of many engineers that could be improved upon. There is a noticeable difference in personality and cultural development of the midwest engineering graduates as compared to those from eastern colleges. Also, the midwest man leans stronger toward a "grass roots" education but he is inclined to be short on perspective and originality.

I also believe there is room for improvement in the use of our language as well as in the ability to clearly and concisely present a proposition, paper, etc.

The economics of production should be more thoroughly instilled in the engineering student. He should be taught it is not sufficient to create something that will work but he must also design so it can be produced at a price acceptable to the public. A large electric equipment company has instituted a program analyzing every product they make to determine the possibilities for cost reduction, performance improvement and simplification.

Industry is rapidly becoming more dependent upon the engineer because of the advances being made in science, technology, etc. The production divisions of companies should be made more attractive to engineering graduates. The possibilities for doing valuable work in production are great. We have a program of inducting engineers into the Sales and Production Divisions every year.

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# Calls for New Supply Methods

Movement of Army supplies from beachhead to front line is literally 100 years behind the rest of our armed effort. Modern mechanical handling equipment could increase the mobility of our armies by 20 to 50 per cent and would release at least one out of every four of present supply troops for vital combat duty. This has been brought out by James R. Bright, editor of *Modern Materials Handling*, Boston, in an address at the annual meeting of The American Society of Mechanical Engineers on Dec. 4 in New York.

A number of devices, used successfully in industry and which could be applied to certain phases of military operations to handle materials mechanically, were described by Bright.

"Even since World War II the amount of material supplied per soldier has grown until it is almost beyond comprehension. The employment of automatic weapons has raised ammunition consumption to new levels—limited only by the fact that present techniques will not supply ammunition at a faster rate.

"Maneuvers in the States create some supply problems in terms of food, clothing, gasoline, and parts supply," he said. "Anyone who was associated with supply under combat conditions will tell you that all this is literally trivial compared to the tonnages that are consumed and must be moved again and again in the course of combat operations."

### Supply Movements

Following the movement of Army cargo from ship to beachhead and docks, he explained that supplies are segregated and moved to base and intermediate depots, usually by classes such as ammunition, medical supplies, rations, or petroleum. From the base depot they may be moved to an intermediate depot, nearer the lines, or in a smaller operation they may go directly to a point where they are issued to troops. The regiment draws the material it needs by sending a detail of men and vehicles which brings supplies to their own small supply center convenient to their front. There are exceptions to this method, but in general, until supplies reach the regiment or division containers have not been opened. Handling is a matter of stacking or moving a vast number of cartons, drums, containers and large artillery shells.

"As the troops advance, supplies are constantly shifted. It is conservative to say that a given carton will be shifted into a minimum of 10 different locations, and more often 50 to 100, before it is finally issued to the using troops!" he noted, pointing out that there is no uniform, Army-wide attack on the handling problem, though the Army Transportation Corps has an extensive materials handling program, with authority over the unloading of ships and clearance of beachheads only. Today, all the armed forces accept and practice unit load handling in the U.S.A., and in major base depots, but it stops far short of the combat zone.

### New Handling Suggested

To meet the problems we should "get away from piece-by-piece handling. Machine-size loads should be moved just as far as possible in the direction of the ultimate user," he said. Self-loading vehicles would eliminate the loading crew of five or six men, loading in one move with one man. Eliminating transfer points would automatically eliminate much handling.

For instance, by the use of hand labor and ship's gear, unit loads could be lowered from an off-shore vessel into landing boats, he explained. At shore a fork truck would go into the craft, pick up a unit load, take it out and stack it at an appropriate spot on the beach or put it on a truck. Thirty cases approximately 13 by 18 by 14 inches (ordinarily carried individually by 30 men) could be taken in one movement with only one man to operate the fork truck. Manhours and loading time are cut considerably, and much damage to material is prevented.

To eliminate transfers the straddle carrier, which can pick up or discharge loads of 10,000 pounds to as high as 22½ tons in less than 15 seconds, could be used to pick up, move and deposit unit loads arranged in master pallets. One man, operating the straddle carrier, can pick up and transport for half a mile 600 tons in the time it would take him to merely load 16 tons by hand.

Because loads can be preassembled and the carrying device is not tied up during loading, far fewer vehicles would be required, reducing congestion and the amount of equipment that now clutters military road networks.

Another possibility mentioned by Bright was the Traveloader which can not only load itself, but can stack one load on top of the other, and can discharge part of its load or exchange one unit load for another.

The aerial ropeway (one in Sweden is 60 miles long) was suggested as practical for moving supplies, especially across rough terrain, because its operation is unaffected by weather extremes; it transports in a straight line between two given points, without any rehandling; no skilled labor is required to operate it; and no bulky material is required for constructing it. Unit loads of 10 to 30 tons could be carried, with speeds of 400 to 2,000 feet a minute pos-


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sible. The ropeway could be extended even after erected and operating, and it would not be very vulnerable to enemy fire.

A portable belt conveyor, another possibility, in continuous operation could do the job of 400 Army trucks. Although more expensive than the aerial ropeway, at five miles per hour with a one-ton unit load spaced every 10 feet it could forward supplies at better than 2,500 tons per hour! Either ropeway or conveyor might transport material directly from ship to supply point.

Other devices suggested included the Army's new amphibious vehicle the BARC, which could carry unit loads from shipside up onto the beach and to base depots; a cargo carrying helicopter, under study by the Transportation Corps; and floating containers, linked together and towed to shore.

To put a program of mechanical handling into action, Bright advocated the creation of a materials handling committee made up of representatives from each supply branch and combat branch of the service, to conduct field experiments and set up a close liaison with the American materials handling industry.

An inter-service materials handling group should be formed to study an integrated handling program, he also stated, as these new methods require coordination from the end of the production line through the continental warehouses, the cargo ships, and so on into the hands of the combat troops.

It is possible that the savings on quantities of supplies and expense of packaging single cases, and reduction of inventories because of faster flow of material, would come close to offsetting the cost of materials handling equipment, he said.

# Air Force to Get New Hangars

Five standardized multi-purpose wing hangars of a newly-designed type are to be erected for the United States Air Force this spring at Lockbourne Air Force Base, Ohio, by the Luria Engineering Company of Bethlehem, Pa., which developed the standardized design from Air Force criteria, plans and specifications.

The hangars are designed to enable Air Force personnel to perform round-the-clock maintenance on medium and heavy bombing and transport aircraft in any kind of weather, according to the Luria concern.

Erection is scheduled to start March 1 this year and to be completed within two months thereafter. George W. Timmons of Columbus, O., is the general contractor.

Each of the hangars will be large enough to house two medium bomber aircraft or one heavy bomber or transport.

The new type hangar, according to Burrell H. Tripp, executive vice president of the Luria firm, was developed to "fill an urgent Air Force need for a closed winterized maintenance facility in which to service medium and heavy aircraft efficiently without subjecting repairs and maintenance to delays caused by inclement weather."

"It also eliminates the necessity of constructing large and costly conventional hangars for maintenance purposes," he added.

The hangar has a structural steel frame, with a clear door opening of 293 feet and a depth that varies from a little over 35 feet at each end to about 126 feet for the center nose pocket.

At the rear, there are five manually-operated sliding doors to allow for the entrance and exit of plane-towing tractors and to facilitate the removal of engines and other equipment. At the rear also are out-swinging access doors equipped with anti-panic hardware to afford quick exit for personnel in case of emergency.

The term wing hanger is used because the structure is designed to cover only the nose and wings of the aircraft. This partial covering of the aircraft requires a door closure to fit around the fuselage of the aircraft where it passes through the hangar doors. In order to accomplish this the patented hangar doors at the center and quarter points of the main-door leaves are equipped with "insert panels" designed as closures to fit around the fuselage of each of the aircraft to be housed. Each closure is made weather-tight by means of a sponge rubber collar that lines the inside of the closure.

The "insert panels" are also designed to permit vertical movement so that the fuselage of the aircraft may move up and down without restriction. Any side movement is absorbed by the resilience of the sponge rubber collar. Each of these door leaves equipped with a closure opening has a sliding panel to close the opening when desired. In addition, most door leaves have knock-out panels for emergency use in the event of fire.

Natural light is admitted to the hangar by means of corrugated translucent fiber-glass panels in the upper portion of all door leaves and along the walls.

Insulation consists of rigid fiberboard of one and one-half inch thickness for the sidewalls and doors. At working levels around the hangar's perimeter, the wall insulation is protected by a covering of asbestos-cement on the exposed surface. All other insulation has a factory applied coat of flame-resisting paint.

Heating is by means of a two-pipe, steam gravity-return system with thermostatically-controlled unit heaters capable of providing a minimum interior working temperature of 50 degrees Fahrenheit.

The heating design is based on two air changes an hour, which is normal for this type of structure. In addition, there are propellor fans on the rear wall which can supply six air changes an hour in emergencies.

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# Mixes Tools — Gets Efficiency

"An amazing amount of ingenuity" in integrating diverse tools and equipment from several foreign countries has led to an efficient and economical production basis in Uruguay.

This comment on Uruguayan industry was made today by Thomas P. Collier, manager of the International department at Armour Research Foundation of Illinois Institute of Technology, Chicago.

Collier recently returned from a preliminary technological audit of Uruguay and left on Dec. 4 for an industrial study of Hawaii. The International department will reveal its recommendations on Uruguay in a final report soon to be released.

Collier declared that an example of Uruguayan ingenuity may be found in the modern textile plants. "They are utilizing equipment purchased from Italy, Switzerland, France, Germany, and the United States in a smooth running operation," he explained.

The average Uruguayan industrialist, Collier stated, is a keen businessman. He frequently shops around in the world markets to determine which country is producing the best equipment at the best price that will suit his particular market requirements, Collier said.

Wool exports, Collier reported, are the principle source of foreign exchange for Uruguay. He said Uruguayans are rapidly improving their techniques in spinning and dyeing wool cloth, and they eventually expect to displace the imported British woolens which have long been a favorite in the Uruguayan market.

The leading Uruguayan citizens frequently expressed their concern over the United States government's tendency to apply a special high tariff on Uruguayan wool, Collier said. But one is immediately impressed with the friendliness exhibited at all places to the United States, he stated.

Accompanying Collier on the Uruguayan mission were L. C. Kinney, assistant manager of the Foundation's chemistry and chemical engineering research department, and I. D. Canton, chief of Latin American operations for the International department.

Collier will head a mission to Hawaii which may result in a more diversified economy for that territory. The mission will study the possibilities of conducting a technological audit of Hawaii.

The exploratory work will be conducted under a grant from the Industrial Research Advisory Council of the Territory of Hawaii to the Armour Research Foundation.

Collier will be accompanied by Maurice J. Day, assistant director for program development at ARF, and Paul B. W. Gollong, chief, Asia and Far East operations, International department.

They arrived in Hawaii on Friday, Dec. 4, and remained there for two weeks. They interviewed industrialists, agricultural leaders, local associations, educators, government officials, and others interested in broadening the economic base of Hawaii.


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## Drive Dummy Piers

Driving steel piles for a Chicago skyscraper that will never be erected began Nov. 18 in a test project being performed for United States Steel Corporation by Armour Research Foundation of Illinois Institute of Technology.

Nine H-beam steel piles of three different sizes were driven into the ground to various depths at a site near Halsted and Harrison Streets. There with the use of specially designed equipment, the steel piles were loaded to the point of collapse. Each pile was subjected to loads up to 800 tons or the equivalent of twenty loaded freight cars.

Electronic instruments measured the amount of strain. These records will serve to determine the capabilities of H-beam steel piles for use in the Chicago "Loop" area as point bearing piles. Point bearing piles are those which are driven through soft clay to hardpan (compacted layer of ground) or bedrock to firmly support a building.

Most of Chicago's downtown area is located on land which consists primarily of layers of clay on top of bedrock.

## Research Belongs

Technical research has established itself as an integral part of the American industrial picture, trade association executives were told Nov. 17 at a conference at Armour Research Foundation of Illinois Institute of Technology, Chicago.

It no longer is a choice between using research and not using research, but a case of which research opportunities to pursue, according to T. E. Veltfort, manager of the Copper and Brass Research association.

The Foundation and the Trade Association Executives Forum of Chicago co-sponsored the meeting, designed to show how research has become available to trade associations in all budget classifications.

Veltfort said practical businessmen are more easily convinced of the need for research if research is directed at a definite rather than a general problem.

"Most desirable in the intelligent selection of research projects by trade associations," he said, "is the formation of a well qualified technical committee made up of outstanding technical experts from the member industries."

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*These items are from information furnished by the Engineering Societies Personnel Service, Inc., Chicago. This SERVICE, operated on a co-operative, non-profit basis, is sponsored by the Western Society of Engineers and the national societies of Civil, Electrical, Mechanical and Mining and Metallurgical Engineers. Apply to ESPS, Chicago and the key number indicated. Prepared ENGINEERS AVAILABLE advertisements limited to 40 words, with typed resume attached may be submitted to ESPS Chicago by members of Western Society of Engineers at no charge.*

## RECEPTIONIST'S CORNER

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C-1497(c) INDUSTRIAL ENGINEER —ME IE 2 plus yrs. exp. in preventative maintenance and cost control or plant layout and cost control. Duties: general industrial engineering in either plant layout and cost control or preventive maintenance and cost control for a processing plant. For a manufacturer of explosives. Salary: $6500. Loc: S. W. Chgo. suburb.

C-1497(b) CIVIL ENGINEER — Must have degree in CE or ME with 2-10 yrs. exp. in light structural steel design, concrete slab and foundation design, and surface road layout and design. Salary: to $6500. Location: 40 miles S.W. of Chicago.

C-1497(a) ELECTRICAL ENGINEER —Must have degree. 2-10 yrs. exp. in power plant and distribution line layout and design. Salary: to $6500. Location: S.W. of Chicago.

C-1496 SALES INSTRUMENTS. Age 30. 3 plus yrs. exp. in sale of electronic instruments in Chicago preferred. Knowledge of process industrial helpful. Duties: sale and electronic instrumentation of instruments — call on industrials and O.E.M's. For a manufacturer of instruments. Sal.: $7500 Employer will negotiate fee. Travel: Chicago area for the most part. Car required. Location: Chicago.

C-1495 PLANT SUPERINTENDENT —ME Prf'd. Age: 30-45 3 plus yrs. exp. in supervisory work in sheet metal fabrication, machine shop, or foundry. Knowledge of integrating all functions of production departments. Duties: supervise all production depts. consisting of 9 foremen of various operations, Production controls, tooling and line balancing, industrial engineering, quality controls, and cost reduction program. For a manufacturer of metal caps. Sal: $7-8000. Employer will negotiate fee. Location: Chicago.

C-1494 SALES ENGINEER — Grad. Arch. or CE age to 35. 3 plus yrs. exp. in design or sale of building products. Duties: sales engineering, sell concrete floor and road decks. Will contact architects, engineers, etc. in Chicago area. Salary to $500 month. Employer might negotiate fee. Car required. Will pay mileage. Location: Chicago.

C-1501 CONSTR. ENGR. & ESTIMATOR. Grad. CE 5 plus yrs. exp. in design, constr. & estimating on sewers, underground constr.: coffer dams, etc. Duties: Gen's. supervision of constr.; design, est. and all around work on sewers, underground const., coffer dams, etc. Salary: Open. Location: Chicago.

C-1500 SALES ENGINEER ME Age: up to 30. Recent graduate or better. Knowledge of stokers or allied fields. Duties: sale of industrial stokers calling on industrials and utilities. For a manufacturer of stokers. Salary: up to $500 per month. Travel 30% Car required. Location: Chicago.

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C-1498 DESIGNER — PLASTICS. Grad. Mech. Eng. 5 plus yrs. exp. in mechanical and plastic die design. Knowledge of plastic molds. Duties: design plastic molds, take customers specifications and determine methods and type of die and mold to design, must know presses and general mechanical equipment. Ability to contact people and act as customer contact man in addition to designer. Salary $6000-8000 per yr. Location: Chicago.

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MW 782 DEVELOPMENT ENGR. 36 One yr. resp. for reduction of faults in sound projectors and tape recorders. Four/one half yrs. resp. for patent of oil diffusion pumps. Forty-two mos. developed office, farm and household equipment. $7500 Midwest.

# Dieselization Nears Completion

Though the domestic railroad dieselization program continues at a high rate, there are indications that the saturation point is approaching, T. F. Perkinson of the General Electric Company, Schenectady, N. Y., told the annual meeting of The American Society of Mechanical Engineers on Dec. 2 in New York. He said, however, that new designs as well as repetitive models are still issuing from builders' plants.

In presenting a survey of progress in railway mechanical engineering for 1952-53, Perkinson reported on locomotives of all types, both foreign and domestic, rail cars and trains, passenger-train cars and freight train cars.

"With the domestic railroads' motive-power inventory heavily stocked with diesel-electrics, U. S. builders are allotting more attention to foreign markets and their requirements for locomotive models peculiarly fitted to work on the generally lighter track structures and smaller gauges found in much of the overseas railway properties," he said.

**Passenger Patronage Declining**

"In the face of continuously declining passenger patronage, the domestic railroads, with few exceptions, are curtailing passenger-train service where regulatory agencies and public sentiment permit, retaining those runs that must be maintained for one reason or another," he stated. "Despite this discouraging atmosphere some efforts are being made to retain or regain passenger patronage by the addition of new passenger-cars, largely, but not entirely, conventional in basic design."

He reported no new or radically different rolling stock for this service, but pointed to the full-length dome-lounge cars as probably "the most outstanding departure from conventional design in passenger-train cars during the year." The first of these were furnished to the Milwaukee Railroad by Pullman-Standard. The upper level under the dome is designed to accommodate 68 seated revenue passengers, while the centrally-located lounge on the lower level affords non-revenue seating for 28 passengers.

**"Piggy-back" Transport**

Considerable attention is being alloted to the "piggy-back" idea of rail transport of highway freight carriers, Perkinson said. Several experimental designs of truck- and trailer-carrying freight-cars, with their associated loading systems, have been developed in recent months.

"Accelerated freight train schedules—particularly those involving perishable lading in refrigerated cars—have demonstrated that currently-available equipment is capable of more intensive utilization when supplemented by suitable servicing facilities and improved operating practices," he continued.

"In some cases the uses of roller-bearings on freight equipment is permitting higher-speed operation than was practicable formerly, with a resultant improvement in service and a betterment of operating costs."

In his survey, Perkinson also discussed the accelerated attention being given the freight-car "hot-box" problem. "A number of patented wasteless lubrication systems and waste-retaining devices, all applicable to the standard AAR freight car journal without change in the journal and box geometry have appeared on the market during the past several years," he said. "Many of these are in revenue service with varying degree of success having been attained."

## *Health Standards Is Subject of Meet*

Methods of raising the occupational health standards will hold the spotlight, when members of the American Industrial Hygiene Association gather for the 1954 Industrial Health Conference, April 26 to 30, at the Hotel Sherman in Chicago.

The five-day meeting will include seminars, speeches, demonstrations and panel discussions which will cover more than ninety topics of interest to industrial management.

Theme of the conference will be "Protecting our greatest industrial wealth—employees' health." The nation's leading hygienists . . . authorities on occupational health . . . will shed new light on subjects ranging from industrial safety, to air-pollution, to occupational diseases.


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# Reviews of Technical Books

## Circuit Theory

*Circuit Theory of Electron Devices,* by E. Milton Boone, John Wiley and Sons, New York, N.Y. First Edition, 1953. 483 pages. $8.50.

In this book the emphasis is on circuit theory rather than the physics of electron devices. It was written primarily as a text for students in electrical engineering. Prerequisites include mathematics through the calculus, sophomore physics, and one year of circuit theory, including some treatment of differential equations, transients and Fourier series.

A study of the high-vacuum tube and its circuit behavior is made in the first part of the book, while later chapters present material on the gas tube and associated circuits.

A discussion of a general four-terminal network is presented, followed by linear four-terminal network theory, applied to vacuum-tube circuits operating in the linear region of their characteristics.

This book is well written with a number of excellent problems included at the end of each chapter. Although written primarily for a text, I believe that it is a worthwhile addition to the library of any engineer who is interested in the subject.

R.G.O., W.S.E.

## Probability

*Handbook of Probability and Statistics with Tables,* by Richard Stevens Burington and Donald Curtis May, Jr., Handbook Publishers, Inc., Sandusky, Ohio, 1953. 340 pages. $4.50.

The scientist who uses statistical tools, as well as the serious student of statistics, will be glad to have, in a single volume of convenient size, the large collection of formulas, procedures, and tables contained in this handbook. Among other things, one will find the properties of the important sampling distributions; procedures for computing the usual confidence intervals and for applying the usual tests of significance, together with examples, statements of the basic theorems of theoretical interest; and the tables most often used in statistical work—all in pleasing typography and format. Much of the material is not otherwise available, except by recourse to a variety of statistical texts and collections of tables.

The major part of the book, especially the more practical part, presupposes only an elementary introduction to mathematical statistics. Several chapters, such as those on generating and characteristic functions and on probability distributions in more than two dimensions, will be of interest to the reader with a more extensive background.

Omissions are, of course, inevitable. Among those noted are formulas for stratified, cluster, and multi-stage sampling and for sampling from a finite population, and, also, tables of random numbers and of probabilities of runs. The normal approximation to the binomial is recommended when n is greater than 30 and .03 is less than p and p is less than .97 (page 197), but the additional requirement that np, or n(1-p) if p is greater than .5, should not be less than, say, 5, is omitted. Nor is mention made of the ½-correction for continuity when n is only moderately large, or of the analogous Yates' correction in applying the Chi-square test to a 2x2 contingency table.

J.M.E.

## Railroading

*Railroad Engineering,* Vol. I, by William W. Hay, John Wiley and Sons, Inc., New York, N.Y., 1953. 483 pages. $7.50.

This textbook consists of two parts: Part I covering Principles of Location and Operation; Part II, Principles of Maintenance and Construction. As compared with older texts in this field which were devoted primarily to reconnaissance, location, surveys, and economics, Professor Hay's treatment in Part I deals with the characteristics of the improved modern locomotive and their effects on railroad grade design and railroad operation. The principles of momentum grades, velocity profiles, and ruling grades are adequately covered. An interesting new feature of the text points out the possibilities of using aerial photography in planning railway location.

Part II of the text discusses problems in connection with acquiring the right-of-way and displays the comparatively new development of the precast concrete crib retaining wall. The coverage of roadbed design which emphasizes soil studies, applications of soil mechanics, draining methods, roadbed stabilization and grouting, is particularly interesting and useful. The treatment of ties and modern railroad rails, their functions and properties, as well as the discussion of the continuously welded rail are pertinent and up to date. Turnout and crossing problems are discussed, also railroad organization and certain principles of economics.

Ample use has been made of pertinent data and diagrams furnished by the American Railway Engineering Association. In the opinion of this reviewer, Professor Hay has written an excellent modern textbook for students of railroad engineering.

E.I.F.

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## WSE Personals

The firm of Sargent & Lundy, Consulting Engineers, 140 South Dearborn Street, Chicago, Illinois, announces the retirement of **Ludwig Skog,** MWSE, Senior Partner, as of December 31, 1953.

Skog was born and educated in Norway, receiving his mechanical engineering degree from Trondheim Polytechnic Institute in 1909. He joined the staff of Sargent & Lundy in 1910 and became Senior Partner in 1947.

He is widely known in engineering circles and is considered as one of the most outstanding electric power station design engineers in the country. He is a Fellow of the American Society of Mechanical Engineers, a member of the American Society for Testing Materials, American Welding Society and has been a member of the Board of Direction of the Western Society of Engineers. He is a member of the Board of Trustees of the Illinois Institute of Technology and a member of the Executive Committee of the Armour Research Foundation. He is also a member of the Union League Club, the Chicago Club and the Norwegian Club.

# Nominating Committee Appointed

To the Corporate Members:

I am pleased to announce that in accordance with Article X, Section 3, of the Constitution, the Board of Direction has appointed a Nominating Committee as follows:

O. W. Eshbach (Board Member)
R. A. Thompson
L. F. Bernhard
H. P. Sedwick
W. W. Pomerhn
A. L. Tholin
H. G. Todman

The Constitution also provides that suggestions for nominees shall be solicited in the publications of the Society.

J. EARL HARRINGTON
Executive Secretary

**Tear off and Return**

To the Nominating Committee, WSE:

I suggest the following names for consideration by your committee for offices indicated.

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**A. Kolflat,** MWSE, who joined the firm of Sargent & Lundy in 1925, has been appointed Senior Partner to succeed Skog.

---

"Engineers Can Wear Petticoats" was the subject of an address by Mrs. **Lois G. McDowell,** AWSE, at a luncheon of the Alumni association of Illinois Institute of Technology on Dec. 10, in the Art Institute club room.

Mrs. McDowell is assistant professor of mechanical engineering at Illinois Tech. She was one of the first four women engineers to study at Rensselaer Polytechnic Institute, Troy, N. Y., and the first to receive a master's degree in mechanical engineering from Illinois Tech.


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## Holds Conference

The Instrument Society of America will hold its 9th Annual Regional Conference on Wednesday, February 4, 1954 at the Hotel Statler in New York City.

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